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REPORT OF COOPERATIVE RESEARCH ON INSECT CONTROL IN FARM STORED GRAIN

No. 19. Period--January 1 to March 31, 1946

Compiled by R. T. Cotton, Entomologist Cereal and Forage Insect Investigations Bureau of Entomology and Plant Quarantine U. S. Department of Agriculture Manhattan. Kansas

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The material in this report consists largely of unpublished data and should be kept confidential. It is made available in its present form for the convenience of the various State and Federal Agencies concerned with the preservation of stored grain from insect damage.

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WHEAT STORAGE

Studies on the Fluctuations of Insect Populations in Wheat Stored under Different Systems of Management*

The study on the fluctuations of insect populations in wheat stored in Ever-Normal granary-type bins has been continued during the quarter. Five-probe samples were taken at monthly intervals from the upper southwest quadrant of 35 bins in the Management Series, and the number of insects by species was determined for each sample. This study has been in progress since May, 1943, and the data have been included in previous quarterly reports. A summary of the data obtained since July 1, 1945 is given in table 1. The population in the untreated 11.5 per cent wheat reached the highest level yet recorded in this study on March 2, 1946.

The comparative abundance of the different species during the period January 1 to March 31 is given in table 2. It should be noted that most of the insects occurred in the untreated control bins of 11.5 per cent moisture. An extremely high infestation of the red flour beetle has developed in them during the winter months.

^{* --} Reported by H. H. Walkden, U. S. Department of Agriculture, Bureau of Entomology and Plant Quarantine in Cooperation with the Bureau of Plant Industry, Soils, and Engineering.

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Table 1..-Summary of the insect populations in the upper southwest quadrant of steel and wood bins, Hutchinson, Kansas, 1945-1946.

		1945		A Ware of	edmiin e	Average number of insects ner 1000 grams	Red ta	JOL 100	O oran	2		1946	
Grain storage practice	July July		Aug.	Aug.	Sept.	Sept.	0ct.	0ct. 20	Nov.	Dec.	Jan.	Feb.	Mar.
1000-bushel steel bins										-			
No treatment: 9.3% moisture	0.24	0.2" 1.0	3.0	1.2	9.t. 4.t.	8.0 4.0	8 4 8 4	2.6	90	8.0	00	00	00
11-11.5% moisture	3.8	9.5	4.0	18.6	13.6	20.8	45.8	31.8	20.4	45.2	86.4	65.2	90.4
White walls and roof	0.2	1.8	4.8	0.6	0.8	1.0	2.8	5.2	1.6	2.8	4.8	0 4.2	0.4.0
Fumigation in August	0	0.9	9.0	4.9 20.3 ^F	1.3	4.5	10.4	24.0 _F (1) 2.3 9.3 1.4	1) 2.3	31.8 _F (1) 2.5 40.9 ^F 23.1	1) 2.5	0.2	0.1
Fumigation in September	0.1.0	0.2	1.4	3.8	8.8	21.3 20.2F	2.0	9.0	2.8	22.1	00.2	0.2	0
Fumigation in August and October	0.1	000	0.5	0.7 4.6F	0.0	0.7	0.3	00	00	00	00	00	00
Turn, clean, and fumigate in September	00	2.4	0 8	1.6	6.4 1.6	13.6F	00	00	00	00	00	00	00

Footnote (1) Dangerous insect populations developed in these bins, necessitating an additional fumigation.

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Table 1 (continued)

		1945		Aver	age nu	mber of	insect	s per	1000 gr	ams		1946	
Grain storage practice	July	July July Aug	Aug.	Aug.	Sept.	18. Sept. Sept. Oct. Oct. Nov. Dec	Oct.	0ct.	Nov.	Dec.	Jan.	Feb.	Mar.
2740-bushel steel bins													
No treatment: White walls and roof	0 0 1	0	0 4.2	0.1	0 6	0.9	1.4	1,2	0.5	0.1	0 0 9	0 k	0 4
Painted white and grouped for shading	0.6	0,5	9.	0 %	2.1	2.0	000	2.9	2 0 2	1.0	0 1.5	0 80	0 4.6
Fumigation in August	0 0 4 7	0.1	0 H	0.8 2,8	0.2	0.2	0.7	1.1	0.0	0.0	00	0.0	0.5
Fumigation in September	0.5	0.2	0,0	3.3	2.1	5.3 4.4	000	0.4	0.8	0.8	0 0 0	0.1	00
Fumigation in August and October	00	0 000	0.5	1.7 2.4	0.1	,00	0 0 2 H	00	00	00	00	00	00
		-	·										

F = Grain fumigated. T = Grain turned and cleaned. " = Weevils: includes lesser grain borer and rice weevil. " = Bran bugs: all species except the weevils. Legend t

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Table 2.--Comparative abundance of the species of stored grain insects found in the bins in the management series, Hutchinson, Kansas, 1946.

4		cent of To		Number
Species	Jan. 2	Feb. 2	Mar. 2	Observed
Red flour beetle (Tribolium castaneum Hbst.)	41.8	36.8	55.8	5966
Long-headed flour beetle (Latheticus oryzae Waterh.)	22.8	20.7	17.5	2536
Lesser grain borer (Rhyzopertha dominica F.)	20.6	24.5	16.4	2499
Flat grain beetle (Laemophloeus minutus Oliv.)	13.3	16.1	9.9	1583
Saw-toothed grain beetle (Oryzaephilus surinamensis L.)	1.4	1.6	0.4	127
Dermestid larvae	0	0.3	0.5	33

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Study of the Amount of Damage Caused by Insects in Wheat Stored in Steel Bins

This study was begun in June, 1943. Samples are drawn from the south quadrant of the bins once each year during the winter months to determine the comparative amounts of insect damage in wheat stored under different management practices. The damage is computed on a weight basis, and any kernel showing insect injury is classed as damaged, regardless of the extent. Insect damage determinations have been made in a total of 65 bins since this study was begun.

A summary of the data obtained from 28 bins is presented in Other bins in the management series showed similar trends. It should be borne in mind that the damage recorded in the table represents the maximum amount in the bin since the samples were taken in the portion of the grain mass where the greatest insect population was known to occur. It may be noted in table 3 that there has been a general increase in insect damage, with the rate of increase being greatest in those bins receiving no treatment. Attention is called to the fact that, even though the amount of insect damage was comparatively slight even in wheat receiving no treatment, the presence of large numbers of insects in it caused the grain to heat, with resultant crusting and molding of the surface grain. When samples are drawn from bins in this condition, both the musty odor of the surface wheat and that of the infested portion is imparted to the whole sample, causing it to be graded "sample grade". Past experience has shown that even though only a small portion of the wheat in a bin may be musty or sour, the whole mass is likely to be contaminated when the bin is emptied. For this reason the amount of indirect damage by insects is much greater than the amount of grain actually consumed.

In the last column of table 3, the total damage is indicated. This figure represents the amount of damaged wheat in average samples from the various bins, as determined by the Chicago Board of Review, and includes damage from any cause. Thus it is evident that the grain mass is much less affected by insects than that in the southwest quadrant.

The results of the insect damage study confirm previous conclusions regarding the various management practices, viz.: (1) fumigation in August and October prevents the establishment of serious insect infestation, thus keeping the amount of insect damage to a minimum; (2) fumigation in September was successful in controlling the infestation but permitted some damage to occur prior to fumigation because of the rapid increase of insect populations during August and early in September; (3) painting the bins white prevented damage for two seasons but failed in the third; (4) the greatest amount of damage, as was expected, occurred in the uncontrolled check bins of 11.5 per cent moisture; (5) comparatively little damage occurred in wheat of 9 per cent moisture.

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Into saudy as begun in the first the first that outh quadrant of the bins one early verting the reason and to determine the comparative and to determine the comparative and the comparative and any kernel encying insure it as a second damaged, regardless of the extent. In set of made in a total of the extent.

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In the last column of table 3, the cotal damage is indicated.

This figure represents the amount of damaged where is average and less that the chicago Berd of Portand includer damage from any course. Thus it is endent the the cream mass is much less affect obvingets that in the courter court of the court.

The results of the in ear dam ge tudy confirm provider our constraing the various magement of cones, vis. (1) and gation in August and October provints the establishment of recipitations in further than and october of the amount of interesting the minimum: (2) funigation in September are entressful in controlling the intestation but permitted some damper to come prior to furgation because of the rapid increase of insect possibilities out the rapid increase of insect possibilities and two seasons but failed in the thirty (4) its porter and two seasons but failed in the thirty (4) its porter and occurred in the urcesticled check time of 115 cm sent mostarry (5) comparatively little deare courted a wheat of 9 per cent coisture.

Table 3.--Comparative insect damage to wheat stored in steel bins, under different management practices, Hutchinson, Kansas, 1943-1946.

Sampling C S SW W Surf. Mean Total damage*				Loc	ation	of samp	le		
1/2-3 Jan., 1944 O O O O O O O O O		Sampling	C	S	SW	W	Surf.	Mean	Total damage*
No treatment, 9 per cent moisture	Bin No.	Date		Per c	ent da	mage, w	reight l	pasis	ave. sample
No treatment, 9 per cent moisture	1000-bus	hel bins							
1/2-3									
Feb., 1945 0.1 0.1 0.1 0.1 0 0.08 1.6 Feb., 1946 0.3 0.4 1.0 0.9 0.5 0.62 1.6 1/2-6		No treat	ment,	9 per	cent m	oisture	2		
Feb., 1945 0.1 0.1 0.1 0.1 0.0 0.08 1.6 Feb., 1946 0.3 0.4 1.0 0.9 0.5 0.62 1.6 1/2-6	1/2-3	Jan., 1944	0	O	0	0	0	0	0.6
Feb., 1946 0.3 0.4 1.0 0.9 0.5 0.62 1.6	1/2 0								
Feb., 1945 0.2 0.6 0.3 0.5 0 0.32 1.0 Feb., 1946 2.1 0.2 0.9 0.9 1.0 1.02 1.4 No treatment, 11.5 per cent moisture 3-10 June, 1943 1.3 0.6 0.4 0.4 0.2 0.58 0.6 Jan., 1944 1.0 1.4 0.2 0.2 0.1 0.58 0.7 Feb., 1945 2.9 11.7 6.1 2.8 5.8 5.86 2.5 Feb., 1946 2.5 4.5 5.3 0.9 5.7 3.78 5.0 3-11 June, 1943 0.3 0.2 0.3 0.2 0 0.20 0.6 Jan., 1944 0.3 0.2 0.2 0.2 0.2 0.2 0.5 Feb., 1945 3.9 8.8 4.3 2.5 2.9 4.48 2.0 Feb., 1946 10.3 9.8 19.8 23.0 6.1 13.80 3.0 White walls and roof 1/2-2 June, 1943 0.1 0.2 0.1 0.1 0.1 0.12 0.7 Jan., 1944 0.1 0.1 0 0 0 0.04 1.0 Feb., 1945 1.4 4.1 7.9 4.2 10.9 5.70 0.9 Feb., 1946 2.7 4.3 4.2 2.8 6.4 4.08 1.0 1-3 June, 1943 0.6 0.2 0.2 0.4 0.2 0.32 0.6 Jan., 1944 0.5 0.5 0.3 0.3 0.5 0.42 0.5 Feb., 1945 0.9 1.2 1.9 2.6 2.4 1.80 0.7 Feb., 1946 2.7 2.6 3.7 2.8 4.5 3.26 0.7 Fumigation in August 1-5 Feb., 1945 1.4 1.2 1.5 2.1 1.3 1.50 0.8 Feb., 1946 1.7 2.4 4.1 1.2 1.2 1.2 2.12 6.6 4-11 Feb., 1945 1.3 1.1 1.1 1.1 1.3 1.18 0.5									
Feb., 1945 0.2 0.6 0.3 0.5 0 0.32 1.0 Feb., 1946 2.1 0.2 0.9 0.9 1.0 1.02 1.4 No treatment, 11.5 per cent moisture 3-10 June, 1943 1.3 0.6 0.4 0.4 0.2 0.58 0.6 Jan., 1944 1.0 1.4 0.2 0.2 0.1 0.58 0.7 Feb., 1945 2.9 11.7 6.1 2.8 5.8 5.86 2.5 Feb., 1946 2.5 4.5 5.3 0.9 5.7 3.78 5.0 3-11 June, 1943 0.3 0.2 0.3 0.2 0 0.20 0.6 Jan., 1944 0.3 0.2 0.2 0.2 0.2 0.2 0.5 Feb., 1945 3.9 8.8 4.3 2.5 2.9 4.48 2.0 Feb., 1946 10.3 9.8 19.8 23.0 6.1 13.80 3.0 White walls and roof 1/2-2 June, 1943 0.1 0.2 0.1 0.1 0.1 0.12 0.7 Jan., 1944 0.1 0.1 0 0 0 0.04 1.0 Feb., 1945 1.4 4.1 7.9 4.2 10.9 5.70 0.9 Feb., 1946 2.7 4.3 4.2 2.8 6.4 4.08 1.0 1-3 June, 1943 0.6 0.2 0.2 0.4 0.2 0.32 0.6 Jan., 1944 0.5 0.5 0.3 0.3 0.5 0.42 0.5 Feb., 1945 0.9 1.2 1.9 2.6 2.4 1.80 0.7 Feb., 1946 2.7 2.6 3.7 2.8 4.5 3.26 0.7 Fumigation in August 1-5 Feb., 1945 1.4 1.2 1.5 2.1 1.3 1.50 0.8 Feb., 1946 1.7 2.4 4.1 1.2 1.2 2.12 6.6 4-11 Feb., 1945 1.3 1.1 1.1 1.1 1.3 1.18 0.5	2 /2 C	70 3044	^	•	•		•	•	2.0
No treatment, 11.5 per cent moisture	1/2-0								
No treatment, 11.5 per cent moisture 3-10 June, 1943 1.3 0.6 0.4 0.4 0.2 0.58 0.6 Jan., 1944 1.0 1.4 0.2 0.2 0.1 0.58 0.7 Feb., 1945 2.9 11.7 6.1 2.8 5.8 5.86 2.5 Feb., 1946 2.5 4.5 5.3 0.9 5.7 3.78 5.0 3-11 June, 1943 0.3 0.2 0.3 0.2 0 0.20 0.6 Jan., 1944 0.3 0.2 0.2 0.2 0.2 0.2 0.2 Feb., 1945 3.9 8.8 4.3 2.5 2.9 4.48 2.0 Feb., 1946 10.3 9.8 19.8 23.0 6.1 13.80 3.0 White walls and roof 1/2-2 June, 1943 0.1 0.2 0.1 0.1 0.1 0.12 0.7 Jan., 1944 0.1 0.1 0 0 0 0.04 1.0 Feb., 1945 1.4 4.1 7.9 4.2 10.9 5.70 0.9 Feb., 1946 2.7 4.3 4.2 2.8 6.4 4.08 1.0 1-3 June, 1943 0.6 0.2 0.2 0.4 0.2 0.32 0.6 Jan., 1944 0.5 0.5 0.3 0.3 0.5 0.42 0.5 Feb., 1946 2.7 2.6 3.7 2.8 4.5 3.26 0.7 Funigation in August 1-5 Feb., 1945 1.4 1.2 1.5 2.1 1.3 1.50 0.8 Feb., 1946 1.7 2.4 4.1 1.2 1.2 1.2 2.12 6.6 4-11 Feb., 1945 1.3 1.1 1.1 1.1 1.3 1.18 0.5									
3-10 June, 1943 1.3 0.6 0.4 0.4 0.2 0.58 0.6 Jan., 1944 1.0 1.4 0.2 0.2 0.1 0.58 0.7 Feb., 1945 2.9 11.7 6.1 2.8 5.8 5.86 2.5 Feb., 1946 2.5 4.5 5.3 0.9 5.7 3.78 5.0 3-11 June, 1943 0.3 0.2 0.3 0.2 0 0.20 0.6 Jan., 1944 0.3 0.2 0.2 0.2 0.2 0.2 0.2 0.5 Feb., 1945 3.9 8.8 4.3 2.5 2.9 4.48 2.0 Feb., 1946 10.3 9.8 19.8 23.0 6.1 13.80 3.0 White walls and roof 1/2-2 June, 1943 0.1 0.2 0.1 0.1 0.1 0.12 0.7 Jan., 1944 0.1 0.1 0 0 0 0.04 1.0 Feb., 1945 1.4 4.1 7.9 4.2 10.9 5.70 0.9 Feb., 1946 2.7 4.3 4.2 2.8 6.4 4.08 1.0 1-3 June, 1943 0.6 0.2 0.2 0.4 0.2 0.32 0.6 Jan., 1944 0.5 0.5 0.3 0.3 0.5 0.42 0.5 Feb., 1945 0.9 1.2 1.9 2.6 2.4 1.80 0.7 Feb., 1946 2.7 2.6 3.7 2.8 4.5 3.26 0.7 Funigation in August 1-5 Feb., 1945 1.4 1.2 1.5 2.1 1.3 1.50 0.8 Feb., 1946 1.7 2.4 4.1 1.2 1.2 2.12 6.6		100;; 1040	2.47	0.2	0.5	0.3	1.40	1.00	#+#
Jan., 1944 1.0 1.4 0.2 0.2 0.1 0.58 0.7 Feb., 1945 2.9 11.7 6.1 2.8 5.8 5.86 2.5 Feb., 1946 2.5 4.5 5.3 0.9 5.7 3.78 5.0 3-11 June, 1943 0.3 0.2 0.3 0.2 0 0.20 0.6 Jan., 1944 0.3 0.2 0.2 0.2 0.2 0.2 0.2 Feb., 1945 3.9 8.8 4.3 2.5 2.9 4.48 2.0 Feb., 1946 10.3 9.8 19.8 23.0 6.1 13.80 3.0 White walls and roof 1/2-2 June, 1943 0.1 0.2 0.1 0.1 0.1 0.12 0.7 Jan., 1944 0.1 0.1 0 0 0 0.04 1.0 Feb., 1945 1.4 4.1 7.9 4.2 10.9 5.70 0.9 Feb., 1946 2.7 4.3 4.2 2.8 6.4 4.08 1.0 1-3 June, 1943 0.6 0.2 0.2 0.4 0.2 0.32 0.6 Jan., 1944 0.5 0.5 0.3 0.3 0.5 0.42 0.5 Feb., 1945 0.9 1.2 1.9 2.6 2.4 1.80 0.7 Feb., 1946 2.7 2.6 3.7 2.8 4.5 3.26 0.7 Funigation in August 1-5 Feb., 1945 1.4 1.2 1.5 2.1 1.3 1.50 0.8 Feb., 1946 1.7 2.4 4.1 1.2 1.2 1.2 2.12 6.6		No treat	ment,	11.5 p	er cent	t moist	ure		
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Feb., 1945 2.9 11.7 6.1 2.8 5.8 5.86 2.5 Feb., 1946 2.5 4.5 5.3 0.9 5.7 3.78 5.0 3-11 June, 1943 0.3 0.2 0.3 0.2 0 0.20 0.6 Jan., 1944 0.3 0.2 0.2 0.2 0.2 0.2 0.2 0.5 Feb., 1945 3.9 8.8 4.3 2.5 2.9 4.48 2.0 Feb., 1946 10.3 9.8 19.8 23.0 6.1 13.80 3.0 White walls and roof 1/2-2 June, 1943 0.1 0.2 0.1 0.1 0.1 0.12 0.7 Jan., 1944 0.1 0.1 0 0 0 0 0.04 1.0 Feb., 1945 1.4 4.1 7.9 4.2 10.9 5.70 0.9 Feb., 1946 2.7 4.3 4.2 2.8 6.4 4.08 1.0 1-3 June, 1943 0.6 0.2 0.2 0.4 0.2 0.32 0.6 Jan., 1944 0.5 0.5 0.3 0.3 0.5 0.42 0.5 Feb., 1945 0.9 1.2 1.9 2.6 2.4 1.80 0.7 Feb., 1946 2.7 2.6 3.7 2.8 4.5 3.26 0.7 Fumigation in August 1-5 Feb., 1945 1.4 1.2 1.5 2.1 1.3 1.50 0.8 Feb., 1946 1.7 2.4 4.1 1.2 1.2 1.2 2.12 6.6									
Feb., 1946 2.5 4.5 5.3 0.9 5.7 3.78 5.0 3-11 June, 1943 0.3 0.2 0.3 0.2 0 0.20 0.6 Jan., 1944 0.3 0.2 0.2 0.2 0.2 0.2 0.5 Feb., 1945 3.9 8.8 4.3 2.5 2.9 4.48 2.0 Feb., 1946 10.3 9.8 19.8 23.0 6.1 13.80 3.0 White walls and roof 1/2-2 June, 1943 0.1 0.2 0.1 0.1 0.1 0.12 0.7 Jan., 1944 0.1 0.1 0 0 0 0.04 1.0 Feb., 1945 1.4 4.1 7.9 4.2 10.9 5.70 0.9 Feb., 1946 2.7 4.3 4.2 2.8 6.4 4.08 1.0 1-3 June, 1943 0.6 0.2 0.2 0.4 0.2 0.32 0.6 Jan., 1944 0.5 0.5 0.3 0.3 0.5 0.42 0.5 Feb., 1945 0.9 1.2 1.9 2.6 2.4 1.80 0.7 Feb., 1946 2.7 2.6 3.7 2.8 4.5 3.26 0.7 Fumigation in August 1-5 Feb., 1945 1.4 1.2 1.5 2.1 1.3 1.50 0.8 Feb., 1946 1.7 2.4 4.1 1.2 1.2 1.2 2.12 6.6 4-11 Feb., 1945 1.3 1.1 1.1 1.1 1.3 1.18 0.5				11.7	6.1	2.8	5.8	5.86	
Jan., 1944 0.3 0.2 0.2 0.2 0.2 0.22 0.5 Feb., 1945 3.9 8.8 4.3 2.5 2.9 4.48 2.0 Feb., 1946 10.3 9.8 19.8 23.0 6.1 13.80 3.0 White walls and roof 1/2-2 June, 1943 0.1 0.2 0.1 0.1 0.1 0.12 0.7 Jan., 1944 0.1 0.1 0 0 0 0 0.04 1.0 Feb., 1945 1.4 4.1 7.9 4.2 10.9 5.70 0.9 Feb., 1946 2.7 4.3 4.2 2.8 6.4 4.08 1.0 1-3 June, 1943 0.6 0.2 0.2 0.4 0.2 0.32 0.6 Jan., 1944 0.5 0.5 0.3 0.3 0.5 0.42 0.5 Feb., 1945 0.9 1.2 1.9 2.6 2.4 1.80 0.7 Feb., 1946 2.7 2.6 3.7 2.8 4.5 3.26 0.7 Funigation in August 1-5 Feb., 1945 1.4 1.2 1.5 2.1 1.3 1.50 0.8 Feb., 1946 1.7 2.4 4.1 1.2 1.2 2.12 6.6		Feb., 1946	2.5	4.5	5.3	0.9	5.7	3.78	5.0
Jan., 1944 0.3 0.2 0.2 0.2 0.2 0.22 0.5 Feb., 1945 3.9 8.8 4.3 2.5 2.9 4.48 2.0 Feb., 1946 10.3 9.8 19.8 23.0 6.1 13.80 3.0 White walls and roof 1/2-2 June, 1943 0.1 0.2 0.1 0.1 0.1 0.12 0.7 Jan., 1944 0.1 0.1 0 0 0 0 0.04 1.0 Feb., 1945 1.4 4.1 7.9 4.2 10.9 5.70 0.9 Feb., 1946 2.7 4.3 4.2 2.8 6.4 4.08 1.0 1-3 June, 1943 0.6 0.2 0.2 0.4 0.2 0.32 0.6 Jan., 1944 0.5 0.5 0.3 0.3 0.5 0.42 0.5 Feb., 1945 0.9 1.2 1.9 2.6 2.4 1.80 0.7 Feb., 1946 2.7 2.6 3.7 2.8 4.5 3.26 0.7 Funigation in August 1-5 Feb., 1945 1.4 1.2 1.5 2.1 1.3 1.50 0.8 Feb., 1946 1.7 2.4 4.1 1.2 1.2 2.12 6.6	3-11	June. 1943	0.3	0-2	0.3	0.2	0	0.20	0.6
Feb., 1945 3.9 8.8 4.3 2.5 2.9 4.48 2.0 Feb., 1946 10.3 9.8 19.8 23.0 6.1 13.80 3.0 White walls and roof 1/2-2 June, 1943 0.1 0.2 0.1 0.1 0.1 0.12 0.7 Jan., 1944 0.1 0.1 0 0 0 0.04 1.0 Feb., 1945 1.4 4.1 7.9 4.2 10.9 5.70 0.9 Feb., 1946 2.7 4.3 4.2 2.8 6.4 4.08 1.0 1-3 June, 1943 0.6 0.2 0.2 0.4 0.2 0.32 0.6 Jan., 1944 0.5 0.5 0.3 0.3 0.5 0.42 0.5 Feb., 1945 0.9 1.2 1.9 2.6 2.4 1.80 0.7 Feb., 1946 2.7 2.6 3.7 2.8 4.5 3.26 0.7 Funigation in August 1-5 Feb., 1945 1.4 1.2 1.5 2.1 1.3 1.50 0.8 Feb., 1946 1.7 2.4 4.1 1.2 1.2 2.12 6.6	-								
### Feb., 1946 10.3 9.8 19.8 23.0 6.1 13.80 3.0 White walls and roof									
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Jan., 1944 0.1 0.1 0 0 0 0.04 1.0 Feb., 1945 1.4 4.1 7.9 4.2 10.9 5.70 0.9 Feb., 1946 2.7 4.3 4.2 2.8 6.4 4.08 1.0 1-3 June, 1943 0.6 0.2 0.2 0.4 0.2 0.32 0.6 Jan., 1944 0.5 0.5 0.3 0.3 0.5 0.42 0.5 Feb., 1945 0.9 1.2 1.9 2.6 2.4 1.80 0.7 Feb., 1946 2.7 2.6 3.7 2.8 4.5 3.26 0.7 Funigation in August 1-5 Feb., 1945 1.4 1.2 1.5 2.1 1.3 1.50 0.8 Feb., 1946 1.7 2.4 4.1 1.2 1.2 2.12 6.6 4-11 Feb., 1945 1.3 1.1 1.1 1.1 1.3 1.18 0.5		White wa	lls an	d roof					
Jan., 1944 0.1 0.1 0 0 0 0.04 1.0 Feb., 1945 1.4 4.1 7.9 4.2 10.9 5.70 0.9 Feb., 1946 2.7 4.3 4.2 2.8 6.4 4.08 1.0 1-3 June, 1943 0.6 0.2 0.2 0.4 0.2 0.32 0.6 Jan., 1944 0.5 0.5 0.3 0.3 0.5 0.42 0.5 Feb., 1945 0.9 1.2 1.9 2.6 2.4 1.80 0.7 Feb., 1946 2.7 2.6 3.7 2.8 4.5 3.26 0.7 Funigation in August 1-5 Feb., 1945 1.4 1.2 1.5 2.1 1.3 1.50 0.8 Feb., 1946 1.7 2.4 4.1 1.2 1.2 2.12 6.6 4-11 Feb., 1945 1.3 1.1 1.1 1.1 1.3 1.18 0.5	1/2-2	Tuna 1043	0.3	0.2	0.1	0.1	0.1	0.12	, 0. 7
Feb., 1945 1.4 4.1 7.9 4.2 10.9 5.70 0.9 Feb., 1946 2.7 4.3 4.2 2.8 6.4 4.08 1.0 1-3 June, 1943 0.6 0.2 0.2 0.4 0.2 0.32 0.6 Jan., 1944 0.5 0.5 0.3 0.3 0.5 0.42 0.5 Feb., 1945 0.9 1.2 1.9 2.6 2.4 1.80 0.7 Feb., 1946 2.7 2.6 3.7 2.8 4.5 3.26 0.7 Fumigation in August 1-5 Feb., 1945 1.4 1.2 1.5 2.1 1.3 1.50 0.8 Feb., 1946 1.7 2.4 4.1 1.2 1.2 2.12 6.6 4-11 Feb., 1945 1.3 1.1 1.1 1.1 1.3 1.18 0.5	1/0-2								
Feb., 1946 2.7 4.3 4.2 2.8 6.4 4.08 1.0 1-3 June, 1943 0.6 0.2 0.2 0.4 0.2 0.32 0.6 Jan., 1944 0.5 0.5 0.3 0.3 0.5 0.42 0.5 Feb., 1945 0.9 1.2 1.9 2.6 2.4 1.80 0.7 Feb., 1946 2.7 2.6 3.7 2.8 4.5 3.26 0.7 Funigation in August 1-5 Feb., 1945 1.4 1.2 1.5 2.1 1.3 1.50 0.8 Feb., 1946 1.7 2.4 4.1 1.2 1.2 2.12 6.6 4-11 Feb., 1945 1.3 1.1 1.1 1.1 1.3 1.18 0.5									
Jan., 1944 0.5 0.5 0.3 0.3 0.5 0.42 0.5 Feb., 1945 0.9 1.2 1.9 2.6 2.4 1.80 0.7 Feb., 1946 2.7 2.6 3.7 2.8 4.5 3.26 0.7 Fumigation in August 1-5 Feb., 1945 1.4 1.2 1.5 2.1 1.3 1.50 0.8 Feb., 1946 1.7 2.4 4.1 1.2 1.2 2.12 6.6 4-11 Feb., 1945 1.3 1.1 1.1 1.1 1.3 1.18 0.5									
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Feb., 1945 0.9 1.2 1.9 2.6 2.4 1.80 0.7 Feb., 1946 2.7 2.6 3.7 2.8 4.5 3.26 0.7 Fumigation in August 1-5 Feb., 1945 1.4 1.2 1.5 2.1 1.3 1.50 0.8 Feb., 1946 1.7 2.4 4.1 1.2 1.2 2.12 6.6 4-11 Feb., 1945 1.3 1.1 1.1 1.1 1.3 1.18 0.5	1-0								
Feb., 1946 2.7 2.6 3.7 2.8 4.5 3.26 0.7 Fumigation in August 1-5 Feb., 1945 1.4 1.2 1.5 2.1 1.3 1.50 0.8 Feb., 1946 1.7 2.4 4.1 1.2 1.2 2.12 6.6 4-11 Feb., 1945 1.3 1.1 1.1 1.1 1.3 1.18 0.5									
1-5 Feb., 1945 1.4 1.2 1.5 2.1 1.3 1.50 0.8 Feb., 1946 1.7 2.4 4.1 1.2 1.2 2.12 6.6 4-11 Feb., 1945 1.3 1.1 1.1 1.1 1.3 1.18 0.5									
Feb., 1946 1.7 2.4 4.1 1.2 1.2 2.12 6.6 4-11 Feb., 1945 1.3 1.1 1.1 1.1 1.3 1.18 0.5		Fumigati	on in	August					
Feb., 1946 1.7 2.4 4.1 1.2 1.2 2.12 6.6 4-11 Feb., 1945 1.3 1.1 1.1 1.1 1.3 1.18 0.5	1-5	Fob 1045	2.4	1.0	, .	0 3	7 "	1.50	0.0
4-11 Feb., 1945 1.3 1.1 1.1 1.1 1.3 1.18 0.5	7-0								
		100. 1340	101	2.4	4.7	1.6	1.6	2+12	0.0
	4-11	Feb., 1945	1.3	1.1	1.1	1.1	1.3	1.18	0.5

^{*} Commercial grade sample, graded by Chicago Board of Review from whole bin.

. . . . THE RESIDENT 41 1 -V - "5 -٠. . . 1

Table 3 (continued)

				Togg	tion o	f samp	10		
	Samp1	ine	C	Foca	SW	W samp	Surf.	Mean	Total damage*
Bin No.	_	-116		r cent			-		ave. sample
-						-	0		
	Fum	igation	in Se	ptembe	r				
7 70	4 10	7045	• •	• •		0.0		0.70	0.4
3-13		1943	0.9	0.2	0.1	0.2	0.1	0.30	0.4
		1945	0.7	0.2	1.1	1.4	1.1	0.30	1.0
	Feb.,		3.4	3.0	0.5	0.8	1.1	1.76	0.8
	100.,	1010	0.1	0.0	0.0	0.0	7.7	1.10	0.0
4-12	June:	1943	0.2	0.2	0.2	0.2	0.8	0.32	0.4
	Jan.,	1944	0.2	0.2	0.1	0.2	0.2		0.8
	Feb.,	1945	2.7	1.1	2.9	1.2	1.4	1.86	1.0
	Feb.,	1946	2.3	3.1	3.8	0.6	3.7	2.70	1,0
	Fum	igation	, Augu	st and	Octob	er			
3-12	June	3043	0.2	0.2	0.1	0.1	0.2	0.16	0.7
0-70	Jan.		0.2	0.2	0.1	0.3	0.2	0.20	0.7
	-		1.0	0.7	0.6	1.1	1.1	0.90	1.0
			0.4	0.3	0.9	0.5	0.9	0.60	0.8
,						1 0			
1/2-5	Jan.,		0	0	0	0.1	0	0.02	0.5
	Feb.,		0	0	0.1	0	0	0.02	1.0
	Feb.,	1946	0	0.8	0.3	0	0	0.22	0.5
1 5	70.00	3044		0.0	^		0.7	0.00	0.7
4-5	Jan., Feb.,		0	0.2	0	0	0.1	0.06	0.3
	Feb.,		0.2	0.1	0.1	0.4	0.4	0.16	0.4
	100.	1040	040	0.1	0.0	0.0	0.4	0.00	0+4
	Turi	n, clear	na fum	igate :	in Sep	tember	44.0		
	170					-1 1	3 10		
3-15	June,		0.4			0.1	0.2	0.28	0.6
			0.1	0.1	0.2	0.2	0.1	0.14	1.2
		1945	0.6	0.5	0.7	0.6	1.1	0.70	
	Feb.,	1946	0.7	1.3	1.6	1.2	1.6	1.28	1.5
2740-bus	hal hi	n.e							
2110-046	nor br	115							
	Whit	te walls	s and	roof					
-		1111		1					
11-9		1943			0.2	0.1	0,1	0.18	5.0
		1944			0.2	0.2	0.2	0.24	5.0
	Feb.,	1946	3.3	4.6	4.9	2.4	9.4	4.92	
12-8	June,	1042	0	0.4	0.7	0.7	0.0	0.24	0 0
20-0	Jan.,		0.2	0.4	0.3		0.2	0.24	2.8 2.5
		1946			1.6	0.6	2.0	1.34	£ • U
				70.7				2001	100
			0 87		(cont	inued)			

eliferranglik all the limit opportunitation of plants and a way is	of the handling was where the	a decementa e para mente		castor within which	Participant and Participant an	anning gyll-talli havet gynn	to hit printing the state of the		ng deronggan, ganganas aga
* grab later	מניית מ		oras lo			0	w co 7	Sampl	
Erg. comp.					in is re		- 44 ا	date	Bin We.
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	emotorion ne estrum	operates extraorder or - 100	The Call	a recommended	01130 40	-	- Office and the control of the control	Commence of property	D y 3 decret
				**	อส์เพอส์สุร	s at a	igation	Fund	
				ward	and that the strain remails all throughout the second	artirostura countri Hanabatan dilan	s, etterior energentetenned hazer	unti arripug a și filib	
0.0	0.30	1.0	5.0	1.0	3.0	6.0		Junes	3-15
1.0	0.30	5.0	0.2	5.0	5.0	0.7		Jan.,	
9+0	1.04	1.1	A.L	I.I	7.0	5.0		Feb.,	
8.0	1.76	1.1	8.0	0.5	0.5	5.4	1946	Feb.,	
3.0	35.0	8.0	5.0	\$ 0	S.O	S.O	7005	Junes	4.12
C	0 18	\$.0	2.0	I.J	\$.0	\$.0		Janes	A SE CAN TO
0.5	38.1	2 . [S.I	5.2	I.l	7.5		Feb.,	
1.0	01.5	3.7	3.7	3.8	3,3	2.3		. del	
	U + 6 d	1 8 0		9.0	A 11 C	0,90	02.0%	4 + CC 2	
			790	dotal	bas tec	E Aus	gation	Fund	
1, 3	B1.0	G.C	100	0.1	5.0	3.0	5761	dunes	51-8
4.0	02.0	5.0	0,3	1.0		\$.0		Jan.,	0,2 0
0-1	05.0	I.I	I.I	8.0		2.0		Feb.	
8 0	05.0	6.0	3.0	8.0	0.5	1.0		Feb.	
	V 10	3 + 3	0,0	3		2 4 4		,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	
0.6	30.0	0	1.0	U	0	0	1944	Jan.	1/2-5
0 1	20.0	0	0	10	0	0	1945	Feb.,	·
0.5	22.0	0	0	2.5	8-0	0	1946	. ds i	
8.0	00.0	0.1	0	0	S. 7	13		Janes	3-2
4.0	31.16	0	0	I.	1.0	Sel		Feb.,	
2.0	0.36	2.0	0.5	013	1.0	0.5	1946	Feb.,	
					and the second		and a	to see a contract	
		~	907937	190 01	nigate	I'SI gII.	SOLO 1	MANAGE	
0.0	88.0	5.0	1-0	5-0	3.0	4.0	1943	June,	3-15
I.I	Alati	0.1	3.0	5.0	I.C	1.0		Jan.,	
4.0	07.0	1-1	0.6	7.0			1045		
2.0	18	1.6	1.2	7.6	8.1	7.0	1946	Feb.,	
							3:	nid Jen	2740-bus
						,			
					201	PILE 8	lian 6	O I I II I	
0.8	0.15	0.1	5.0	5.1			1943	Junes	II.
5.0		8.0		9.0	5.0	4.0	1944	1311.	
rigo spira	20.0	9.4	4,5	8 . 2		3.3	1946	, , तंबच	
4.0	60.0								m 131°
8.0		3.0						June	12-8
3.3		8.0			0.5				
e= epb	2.5	0.5	2.6	0.7	2.0	Tail	23.67	4.084	

(bountiane)

Table 3 (continued).

Bin No.	Sampl	ing	C	S	SW	of sam	Surf.	Mean basis	Total damage* ave. sample
Dan Hot	4400			101 00	10 4411	-Bo) "	016110	,	avov bumpzo
	Pai	nted wh	nite a	nd gro	uped				
7-8 (SW	June,		0.1	0.1	0.2	0.1	0.2	0.14	1.0
bin in	Jan.,		0	0.3	0.2	0.4	0.2	0.22	0.5
group)	Feb.,	1946	1.2	2.3	1.9	1.0	3.2	1.92	0.7
7-9 (NW	June,		0.3		0.2	0.2	0.2	0.22	0.8
bin in		1944	0.2			0.2	0.3	0.30	0.6
group)	Feb.,	1946	1.5	0.5	0.5	0.7	1.4	0.92	0.6
8-7 (SE		1943	0.1	0.2	0.1	0.1	0.2	0.14	0.7
bin in		1944		0.2	0.4	0.2	0.1	0.26	0.8
group)	Feb.,	1946	0.8	0.2	0.5	0.3	0.6	0.48	0.7
8-8 (NE	June,	1943	0.2	0.1	0.3	0.1	0.2	0.18	0.5
bin in	Jan.,		0.2	0.3	0.3	0.4	0.3	0.30	0.6
group)	Feb.,	1946	0.2	0.8	0.7	0.2	1.5	0.68	,1.0
	Fum	igation	in A	ugust					
7-7	Apr.,	1944	0.1	0.2	0.1	0.1	0	0.10	0.4
	Feb.,		0.4	0.7	0.4	0.8	0.7	0.60	
8-2	Apr.,	1944	0	0	0	0	0.1	0.02	0.4
	Feb.,		0.2	0.4	0.2	0.5	0.6	0.38	0.4
8-3	Apr.,	1944	0.1	0	0	0	0	0.02	0.5
	Feb.		0.5	0.3	0.6	0.7	0.8	0.56	0.4
8-6	Apr.,		0.1	0.1		0	0.1	0.08	0.3
	Feb.,	1946	0.7	0.5	1.2	0.2	0.7	0.66	0.3
	Fum	igation	in Se	eptembe	r				
7-3	Apr.,	1944	0.3	0.2	0.1	0.1	0.2	0.18	1.0
	Feb.,	1946	0.9	1.5	1.9	0.7	1.4	1.28	0.8
11-10	June,	1943	0.3	0.1	0.1	0.1	0	0.12	1.5
									3.5
	Feb.,	1946	1.8	4.6	1.1	1.3	3.5	2.46	4.0
11-11	June,	1943	0.3	0.1	0.6	0.2	0.2	0.28	1.2
	Jan.,	1944	0.6	0.2	0.2	0.2	0.2	0.28	2.4
	Feb.,	1946	2.4	0.8	0.6	0.3	0.8	0.98	5.0
	Fumi	gation	in Au	igust a	nd Oct	ober			
9-1	June,	1943	0.1	0.2	0.1	0.1	0.2	0.12	0.3
	Jan.,	1944	0.3	0.1	0.1	0.1	0.2	0.16	0.4
	73 - 3	2040	^ ~	^ .				0.42	0.5

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Effect of Temperature, Moisture, and Dockage on the Survival and Reproduction of the Red Flour Beetle*

In Report No. 18 partial results were reported relative to breeding experiments of the red flour beetle at a constant temperature of 65° F. These experiments were completed during the quarter, and data on the percentage of survival of adults are summarized in table 4. In the 9% moisture wheat adult survival increases in direct proportion to the amount of dockage present. In clean wheat of this moisture content there were no survivors at the end of 19 weeks whereas in the wheat with the 8% dockage the survival was 85%. In the 12 and 15% wheat the effect of dockage on survival was not so evident.

In table 5 is given a record of the eggs laid by 10 female red flour beetles at this temperature in flour of 9, 12, and 15% moisture, over a period of 12 weeks. A greater number of eggs were laid in the 12 and 15% moisture flour than in the 9% moisture flour. At this temperature the development of the larval stage is extremely slow and in the adult survival test series referred to, no pupae were recovered from any lot during the 19-week period over which observations were made.

Table 4.--Percentage of survival of the red flour beetle in 9, 12, and 15% moisture wheat with varying amounts of dockage at 65° F. (Continued from Oct.-Dec. 1945 Report).

				P 1 P						BCT
Moisture content of	•			rcenta			after			
wheat and	: 11 8	12	: 13	: 14	2 15	: 16	1 17	: 18	\$	19
food media	weeks:	weeks	weeks	:weeks	:weeks	:weeks	:weeks	:week:	s: Y	reeks
000 mm1	:		•	\$:	3	:	3	:	
9% Wheat		-110	•	•	:	1	1	•	:	-
Clean wheat	: 0:	0	1 0	: 0	: 0	: 0	: 0	: 0	:	0
Same + 0.5% Dock.				: 30	, , , ,		: 20	: 15	\$	15
Same + 1.0% "	: 75 :			: 65				: 45	1.	35
Same + 2.0% **	: 70 :	55	: 55	\$ 55	: 55	: 55	: 50	; 40	:	40
Same + 4.0% "	: 85 :	75	£ 75	: 75	: 75	: 75	: 75	: 75	:	75
Same + 8.0% "	: 100 :	100	: 95	: 95	1 95	: 95	1 90	\$ 85	:	85
	: :		:	:	:	:	:	:	2	
12% Wheat	:		:	:	:	:	;	:	2	
Clean wheat	95 :	85	: 85	: 85	1 70	: 70	65	: 45	:	45
Same + 0.5% Dock	75 :	75	: 75	: 75		474	2 75	\$ 75		75
Same + 1.0% "	95		: 90			: 90		: 90		90
Same + 2.0% "	90	W 34 1				: 80		: 75	1	75
	85		: 75			: 75		: 75	:	75
Same + 8.0% "	90	THE P. LEWIS CO., LANSING, MICH.	: 90	: 90		: 90	: 90	: 90		90
Damo + 0.0/6		30	. 30	• 30	. 30	. 30	. 30	• 30	•	30
15% Wheat			•	•		-1				
Clean wheat	85	85	: 85	: 85	85	: 85	: 80	÷ 75	•	75
Same + 0.5% Dock.				: 95	-	: 95		: 95	*	95
	95			: 90				: 90	•	
0 0 1	80			: 80					•	90
							• 00	: 80	•	80
Salue + 1.0%				: 70				: 40	:	40
Same + 8.0% "	60	55	: 55	: 55	5 5	: 55	: 55	: 55	:	50
		-	•	5	4.	À	;	:	:	

^{* --} Reported by R. T. Cotton and J. C. Frankenfeld.

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^{* --} Reported up R. T. tolog, and J. C. Francomiald.

Table 5.--Egg laying record of 10 female Tribolium castaneum over a period of 12 weeks at 65° F.

				Number	eggs	laid by	10 fem	ales	in	
Date	5	9% mois	ture	flour :	12% m	oisture	flour	: 15	% moisture	flour
	÷			:				:		
12/21/45	:		0	:	1	0		:	7	
12/27/45	:		0	:		5		:	3	
1/4/46	:		0	:		10		:	5	
1/11/46	:		0	:		6		:	5	
1/18/46	:		0	:		8		2	5	
1/25/46	:		0	:		9		:	5	
2/1/46	:		6	1		11		:	10	
2/8/46	:		8			13		:	13	
2/15/46	:		4	:		14		:	8	
2/22/46	:		10			8		:	9	
3/1/46	:		14	:		7		:	10	
3/8/46	:		32	•		18		•	27	
-, -, -,	:							•	,	
Totals	•		74			109		•	107	
100010	•		, 4	•		703			101	
	•			•				•		

The survival and reproduction of the red flour beetle in a similar series held at a constant temperature of 75° F. was reported on, in Report No. 18 for a period of 16 weeks. Observations on this series have now been completed and final data are given in table 6. As in the series held at 65° F, the amount of dockage present did not affect adult survival except in the 9% moisture series where survival was in direct proportion to the amount of dockage present.

Reproduction was not extensive at this temperature but increased with an increase in moisture content and with an increase in the amount of dockage present.

Egg laying records of the red flour beetle and the confused flour beetle at this temperature are summarized in table 7 for a period of 24 weeks to show the effect of changing the food at weekly and monthly intervals on fecundity. It will be noted that there was little difference between the number of eggs laid by adult females when the food was changed at weekly or monthly intervals. However, when the food was unchanged, a very much smaller number of eggs were laid by both species.

The confused flour beetle adults laid on an average nearly twice as many eggs over the period as the red flour beetle.

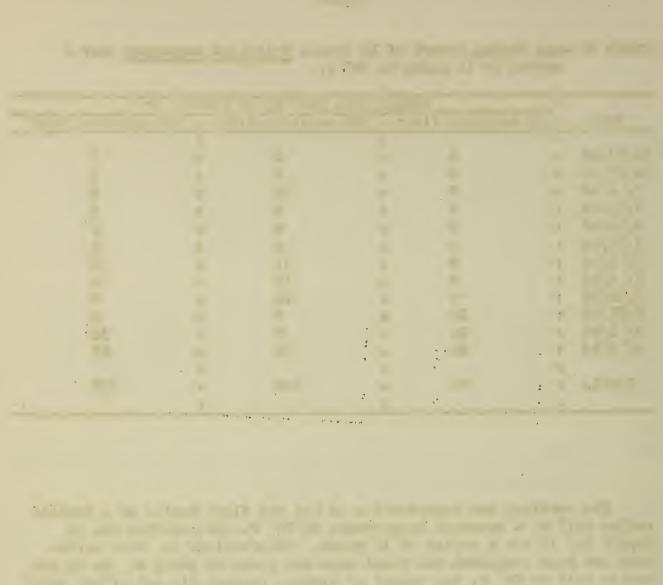


Table 6.--Percentage of survival of the red flour beetle in 9, 12, and 15% moisture wheat with varying amounts of dockage at 75° F.

Moisture content of	: Percent	tage surviv	ral a	fter	:Total	progeny
wheat and food media	: 17 weeks					
	1	:	:		:	
9% Wheat	:	:	:		:	
Clean wheat	: 0	: 0	:	0	1	0
Samo + 0.5% Dockage	: 30	: 20	:	5	:	11
Same + 1.0% "	: 65	: 65	:	65	:	9
Same + 2.0% "	: 80	: 80	:	80	:	27
Same + 4.0% "	: 95	90	:	90	:	39
Same + 8.0% "	: 85	: 75	:	75	:	45
·	:	:	:			
12% Wheat	:	:	:			
Clean wheat	: 80	75	:	65	:	17
Same + 0.5% Dockage	: 90	90	:	90		67
Same + 1.0%	: 95	95	;	95	:	40
Same + 2.0% "	: 95	95	:	95	:	79
Same + 4.0% "	: 80	: 80	:	80	\$	66
Same + 8.0% **	: 90	: 90	:	80	:	95
	:	:	:		:	
15% Wheat	:	:	:		:	
Clean wheat	: 85	: 85		85	:	24
Same + 0.5% Dockage	: 95	: 90	:	90	:	70
Same + 1.0% "	90	90	:	90	*	108
Same + 2.0% "	: 90	: 90	:	90	:	146
Same + 4.0% "	1 90	85	:	85	:	136
Same + 8.0% "	: 95	90	:	90	1	157
	:	:	:		:	

Table 7.--Egg laying record of 10 female T. castaneum and 10 female
T. confusum over a period of 24 weeks at 75° F. and 46% R.H.

-	:	Nu	mber eg	gs]	aid by	10 fer	males	of		-
	:		taneum			*		confusum	1	
Egg	: Food	;		:		: Food	:		:	
laying	:changed	:Food c	hanged	: F	ood	:change	ed:Fo	od change	d:	Food
period	:weekly	:every	4 weeks	:unc	hanged	:weekl;	y :ev	ery 4 wee	ks:u	nchanged
1-12 weeks	: 1759	: 1	561	•	783	: 250	3 !	2405	•	1127
13th week			159	:	106	: 22'		248		121
14th week		•	143	2	118	: 27	-	259		150
l5th week	: 144	:	112	:	94	: 292		298	:	161
16th week	: 129	;	163	:	94	: 310	3 0	331	:	175
17th week	: 73	:	162	:	93	: 312	:	363	:	183
18th week	: 67	:	117	:	112	: 28	3 :	310	;	175
19th week	: 80	:	93	:	128	: 209	:	296	:	182
20th week	: 31	1	82	:	96	: 169	3 :	254	:	184
21st week		:	48	:	111	: 15		237	:	131
22nd week		:	75	:	100	: 119		193		179
23rd week 24th week	: 10	:	46 38		80	: 12:		190	:	161
SAIN MAAK	: 11	:	30	:	56	: 113	•	157		132
Totals	2746	: 2	799	:	1971	: 5100) :	5541		3061
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female	: 274-6	: 27	9.9	: 1	197.1	: 510	:	554.1	:	306.1

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In another series of tests with both the red flour beetle and the confused flour beetle a constant temperature of 95° F. was maintained. Data regarding the survival and reproduction of these two species at this temperature are given in tables 8, 9, 10, and 11.

It will be noted that this temperature is not favorable for the survival of either species. The percentage of dockage present affects survival only in the 9% moisture series, an observation that seems to hold true at all temperatures.

Up to a certain point reproduction increases with both an increase in moisture and an increase in the amount of dockage present. Reproduction is rapid at this temperature and the first pupae were recovered at the end of the third week.

Egg laying records of 10 female red flour beetles for an eleven-week period are given in table 12. It will be noted that where the food was changed at weekly intervals egg oviposition took place at a much faster rate than where it was not changed.

Table 8.--Percentage of survival of T. castaneum in 9, 12, and 15% moisture wheat with varying amounts of dockage at 95° F.

Moisture content:	<u> </u>				Per	rcent	SI	rviv	al aft	er						
of wheat and	1:	2	: 3	:	4	5	:	6	: 7	:	8	: 9	:	10	:	11
food media	week:	weeks	:weeks	s :we	eks	:weeks	: V	veeks	:weeks	:we	eks	:week	s : W	eeks	:we	eeks
9% Wheat			:	:		:	:		:	:	-	:	:			
Clean wheat	15:	0	:	•		è	į		•	•		•	•		•	
Same + 0.5% Dock.		55	4 5	Ī	30	25	:	15	. 0			:			:	
Same + 1.0% "	80:	70	: 65		60		:	50	: 30	:	20	: 10	:	10		10
Same + 2.0% "	80:	70	: 70		25	25	:	20	: 15	:	15	: 5	:	0	:	
Same + 4.0% "	95:	80	: 60	:	0	:	:			:		:	:			
Same + 8.0% "	80:	75	: 75	:	55	: 55	•	55	: 55	•	55	: 55	:	50	•	50
	:	, -	:	:		:			:	:		:	:		:	
12% Wheat	: :		:	:		:	:	;	:	:		:	:	:	:	
Clean wheat	95:	90	: 70	:	40	: 15	:	15	: 15	:	10	: 5	:	5	:	5
Same + 0.5% Dock.	95:	85	: 80	:	0	:	:	:		:		:	:			
Same + 1.0% "	90:	85	: 20	:	0 :	:	:	;	:	:		:	:			
Same + 2.0% "	85:	55	: 15	:	0 :	:	:	:		:		:	:			
Same + 4.0% "	95:	25	: 20	:	20	20	:	20	20	:	20	: 20	:	20		20
Same + 8.0% " :	100:	90	: 10	:	10	: 10	:	10	• •	:	10	: 10	:	10		10
, i	:		:	:			:			:		:	:			
15% Wheat	:		•	:			:			:		:	•			
Clean wheat	100:	100	: 100	:	90	85	:	85	80	•	65	: 55	:	35		20
Same + 0.5% Dock .:	100:	100	95	:	0 :		:			:		:	•			
Same + 1.0% " :	100:	95		•	0 :		:			•		•	•			
Same + 2.0% "	100:	25		:	25	25	:	25	25	•	25	. 25 [*]	k			
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^{*} Started 2 weeks later than rest.

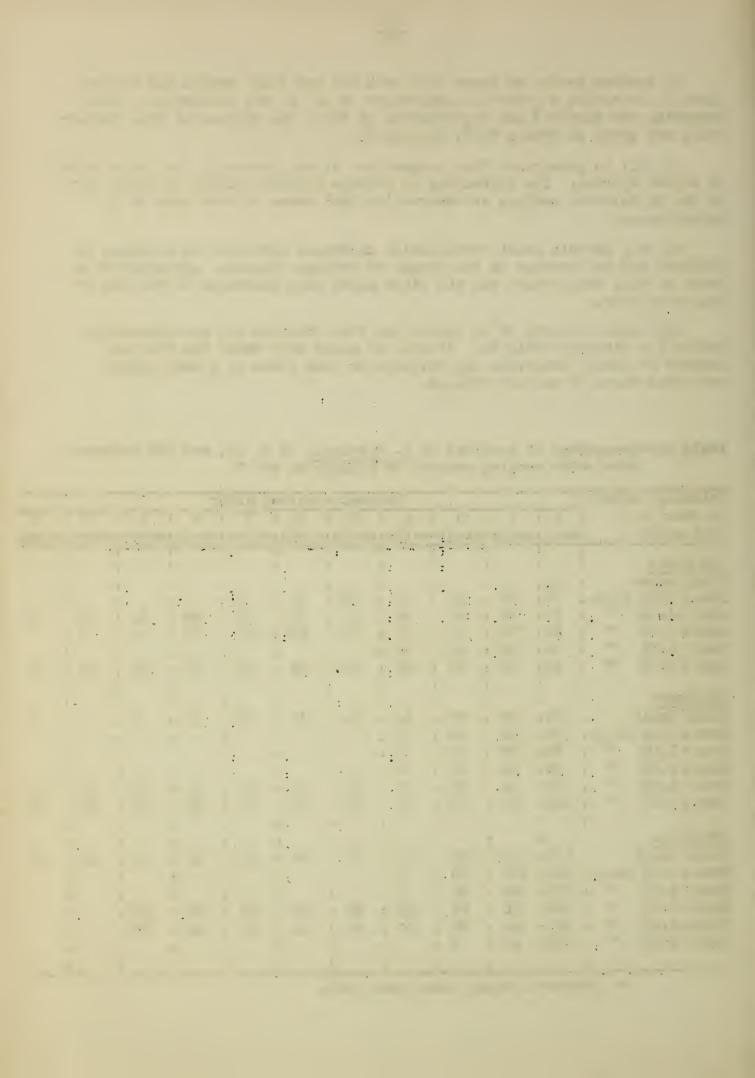


Table 9 .-- Weekly recovery of T. castaneum from 9, 12, and 15% moisture wheat with varying amounts of dockage at 95° F.

Moisture content		Num	ber of	pup	ae re	cover	ed af	ter	:	
of wheat and	3rd	:4th	:5th	6th	:7th	:8th	:97n	:10th:	lith:	
food media	week	week	:week	week	:week	:week	week	:week:	week:	Total
		:	;		:	:	:	: :	:	
9% Wheat	;	:	: :		:			: :	:	
		•	: :	:	:	\$	1	: :		
Clean wheat		:	: :		:	3"	:	: :	:	
Same . 0.5% Dockage		:	: :	2	z 7	: 4	: 1	: 1:	0 :	15
Same + 1.0% " :	;	: 2	: 7:	14	: 9	: 0	: 1	: 2:	3 :	38
Same + 2.0% " :		: 1	: 15 :	19	: 6	: 5	: 1	: 0 :	1:	48
Same + 4.0% "		: 4	: 20 :	1	: 5	: 4	: 2	: 0:	0:	36
Same + 8.0% "		: 9	s 35 s	16	: 3	: 23	: 2	: 12 :	7 :	107
		:	: 1		:	•	:	: ;	2	
12% Wheat		:	: :	:	:		:	: :	ź	
		•	: :		*	1	:	: :	:	
Clean wheat		: 7	20	7	: 9	: 0	: 0	: 0:	1 :	44
Same + 0.5% Dockage:			: 24	16	: 10	: 0	: 0	: 0:	0:	83
Same + 1.0% " :			: 25		: 0	: 0	: 0	: 0:	0 :	57
Same + 2.0% "	1	: 12	: 12 :	1	: 9	: 4	3 0	: 13 :	0:	52
Same + 4.0% "		•	: 1:			: 17	: 17	: 19 :	16 :	160
Same + 8.0% " :	3	: 27	: 69 :	2	: 57	: 53	: 8	: 68 :	28 :	313
		:	1 1	:	:	:	:	: :	2	
15% Wheat		•	: :	1	:	1	•	: :	8	
		:	: :		:	:	*	: :	,	
Clean wheat	34	: 52	: 23 :	15	: 7	: 7	: 1	: 2:	3 :	144
Same + 0.5% Dockage:			: 32 :		: 2	: 2	: 0		0:	103
Same + 1.0% ":		: 28	: 16 :	0	: 2	: 0	: 0	: 0:	0:	73
Same + 2.0%	4	: 7	: 57 :		•	·	: 6*	-	:	137
Same + 4.0%		_	: 71 :		: 6	: 41	: 2*	: :	:	185
Same + 8.0% ** :	11	: 18	: 73 :	2	: 13	: 0	: 1	: 0:	0 a	118
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^{*} Started 2 weeks later than rest.

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Table 10.--Percentage of survival of the confused flour beetle in 9, 12, and 15% moisture wheat with varying amounts of dockage at 95° F.

				· · · · · · · · · · · · · · · · · · ·					-		
Moisvure content				Perce		rvival	after				
or wheat and	: 1	: 2	3 :	4:	5	: 6	: 7 ;	0 6		10 s	
food media	:week	:weeks	weeks	weeks:	weeks	:weeks	weeks;	weeks:	weeks :v	veeks:	weeks
	:	•	3	•		:	:	;	:		
% Wheat	:	:	:			:	:	:	:	:	
A* 1	:	:	•	:		:	:	:	:	:	
Clean wheat	: 25	: 0 :				:	: :	:	:		
Same + 0.5% Dock.		: 70 :	: 70 :	50 :	10	: 0 :	: :	:	:	:	
dame + 1.0% "	• • •	: 75	: 75 :		65		: 15 :	10:	0:	:	
Same + 2.0%	•	: 75				• ~ ~	: 0:	:	:	:	
•		: 40			35	• • •	25 :		15:	15 :	15
Same + 8.0% "	:100	95	: 80 :	80 :	70	: 65	: 50 :	50 :	45*:	:	
	:	•	:	:		:	:	:	:	:	
12% Wheat	•	:		:		•	•	:	;	:	
	:	•		:		:	:	:	:	:	
Clean wheat	: 95	: 75	75	45 :	10	: 10	: 5:	5:	5:	5 :	. 0
Same + 0.5% Dock.		: 80	: 80 :		10		25 :		20:	20 :	
0	: 85	85			20	: 20	20 :	15:	10:	10 :	10
	: 95	95	• • • •	0:		:	: :	:	:	:	
-	:100 :	. 100		0:		:	: :	:	:	:	
Same + 8.0% "	: 85	85	70 :	0:		4	: :	:	:		
	:	:		:		•	:	:	:		
15% Wheat	:	:	:	:		:	: :	:	:	:	
	:			:		:	: :	:	:	:	
	:100	: 100 :	: 100 :	100:	100	: 80	65 :	60 :	40:	35 :	35
Same + 0.5% Dock.		30	30		•	: 25	25 :	25 :	20:	15 :	5
• .	:100	: 100 :			•				30*:	:	
·	: 85						: 55 :	55 :	55*:	:	
Same + 4.0% "	: 95	: 70 :	70 :	60 :	55	: 55	: 55 :	55 :	50*:	:	
Same + 8.0% "	: 95	90 :	0:	0:		:	:	:	:	:	
	:			:		:	:	:	:	:	

^{*} Started 2 weeks later than rest.

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Table 11.--Weekly Recovery of T. confusum from 9, 12, and 15% moisture wheat with varying amounts of dockage at 95° F.

Moisture content :		Nu	mber 1	oupae	recov	rered	after		
of wheat and	3rd						9th:10t	h:11th	
food media :	week	:week	:week	week	:week	week:	week:wee	k;week:	Total
		:	:	:	:		:	:	
9% Wheat		:	:	•	:	:	•	:	
Clean wheat	00	: 0	: 0 :	•	ŧ	: _ :	.	*	: 0
Same + 0.5% Docks		: 1	: 8 :	: 0	: 10 :	7 :	1:0	: 0 :	27
Same + 1.0% ":	0			: 20		: 28 :	5:2	: 3	: 101
Same + 2.0% ":	0		: 23	: 24	: 23	: 4:	3 : 2	: 1	83
Same + 4.0% ":	0		: 49	: 22	: 18 :	: 7:	5:5	: 7	115
Same + 8.0% ":	0	: 60	:125	: 49	: 21	: 30 :	22*:	:	307
300 110		:		:	:		:	*	3
18% Wheat	_	•	•		•				
Clean wheat :	3	: 1	: 12	: 18	: 3	: 1:	0:0	: 1 :	39
Same + 0.5% Dock:		: 36	: 19	3	: 7	4:	4:0	: 0 :	103
Same + 1.0% ":	43	: 33	: 37	: 7	: 3 :	. 7 :		: 7	159
Same + 2.0% ":	17	: 20	. ~~	: 0	: 0 :	: 1:	1 : 12	: 10	81
Same + 4.0% ":	4	: 3	•	: 0	: 0 :	: 0 4		: 0	: 10
Same + 8.0% ":	0	: 13	: 51	: 1	: 1:	2:	0 1 0	: 0	68
3 = 1 1		:	•	•	ŧ ;			:	
15% Wheat		:	•	•	4		:	:	
Clean wheat :	31	: 50	: 31	: 10	: 19	12 :	4:8		204
Same + 0.5% Dock :		: 38		5	: 14 :	6 1	11:18	: 18	: 168
Same + 1.0% " :	24	: 73	: 74	: 23	• •	: 33 :	22*:	:	254
Same + 2.0% ":	12	: 82	: 52	: 18	: 28	54:	23*:	4	269
Same + 4.0% " :	11	:106	: 75	: 12	• •	86		:	330
Same + 8.0% "	21	: 55	: 47	: 3	; 4	: 1:	0:1	: 0	132
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Table 12.--Egg laying record of 10 female Tribolium castaneum during 11-week period at 95° F. Moisture content of flour 12%.

	:	Number eggs	laid	by 10 females
Date	:	Food changed weekly	:	Food unchanged
	;		:	
1-17-46	:	18	\$	25
1-21-46	:	184	:	137
1-23-46	:	191	:	116
1-25-46	:	120	:	63
1-29-46	:	304	:	122
2- 1-46	:	174	:	138
2- 6-46	:	248	:	130
2- 8-46	:	73	:	70
2-13-46	:	84	:	7 5
2-15-46	:	30	:	48
2-18-46	:	. 62	:	64
2-22-46	:	13	:	57
2-26-46	:	47	•	42
3- 1-46	ŧ	72	:	8
3- 5-46	:	34	•	15
3-88-46	:	64	:	18
3-12-46	:	7	•	0
3-15-46	:	8	•	O
3-19-46	:	6		Ŏ
3-22-46	•	3	:	0
3-26-46		Ö		0
3-29-46		0	2	Ö
	:	•	•	
Totals	•	1742	•	1128
200020	•	2120	•	7.7%

		Court Congression		
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